SYSTEM

The present invention relates to a system.

In industrial systems, it is known that drive units can be powered from a network. For this purpose, drive units are mostly connected via expensive plug-and-socket connectors. In addition, the system or machine has a T-piece for each drive unit as an energy branch. These T-pieces are difficult to install and expensive, in particular when they must be usable and provide a high degree of protection in wet areas or even aseptic areas.

Therefore, the object of the present invention is to provide simpler and more cost-effective wiring in drive units and systems.

The object of the present invention is achieved by the system having the features indicated in Claim 1.

In the case of the system, the essential features of the present invention are that it includes drive units, which are powered on a movable part, in particular a turntable or linear drive, in a contact-free manner, using, in each instance, an inductive coupling to one or more primary conductors. In this context, it is advantageous that the wiring may be implemented simply and rapidly and, in addition, in a well-arranged manner. Moreover, the system may be used in wet areas and in aseptic areas, since the inductive coupling allows the housing to be manufactured to be smooth. Furthermore, power is transmitted in an erosion-free manner.

It is also advantageous that the power supply to the drive units is voltageless, and that the carrying-over of voltage

otherwise present in systems, as well as spark-suppression devices in disconnecting switches, may be eliminated. In addition, reactive-power compensation is made possible, in particular in the drive unit, and therefore the alternating current has smaller values, which is why smaller wire diameters may also be provided in the case of primary conductors, and lower wiring costs are therefore attainable. Disconnecting switches may be eliminated, since interruption may be replaced by extraction of the primary conductor.

In one advantageous refinement, the part is rotationally mounted or linearly movable. In this context, it is advantageous that the system may be manufactured as a turntable or a linear drive.

In one advantageous refinement, the primary conductor powers the drive units in series. The advantage of this is that T-pieces are not necessary, and that highly cost-effective wiring is implementable, in particular without plug-and-socket connectors and the like.

One advantageous embodiment provides for the primary conductor to be supplied with energy in a contactless manner via stationary coil cores containing at least one coil winding, or to be supplied with energy via a loop wire. An advantage of the contactless transmission is that the movable part may be used, in turn, in wet areas or aseptic areas, and that no erosion occurs.

In one advantageous refinement, the primary conductor is laid as a closed loop. In this context, it is advantageous that it is particularly cost-effective, and that no starting pieces or end pieces are necessary.

In one advantageous refinement, at least one drive unit includes an electric motor and an electronic circuit for powering the electric motor, the drive unit being able to be powered inductively. In this context, it is advantageous that the drive unit may be manufactured in a cost-effective manner to be impervious and to provide a high degree of protection, for the contactless powering of the drive unit allows the housing to be manufactured simply and easily, in particular without uneven areas or plug-and-socket connectors, and therefore allows water to drain off and the settling of solids to be prevented. Therefore, it is particularly usable in wet areas and aseptic areas. The present invention allows the time necessary for wiring to be reduced.

In one advantageous refinement, a primary conductor is provided on the drive unit in such a manner, that an inductive coupling to a secondary winding contained by the drive unit is providable. In this context, it is advantageous that a plug-and-socket connector is not necessary, and that the wiring may therefore be carried out in a simple and rapid manner. In addition, it is possible to reduce costs.

In one advantageous refinement, at least one primary conductor is provided in a groove or a cable duct of the drive unit. In this context, it is advantageous that the cable may be laid very simply and rapidly, and that in addition, encapsulation with encapsulating material may be advantageously carried out.

In one advantageous refinement, at least one secondary winding is wound around a U-shaped and/or E-shaped core. In this context, it is advantageous that the design may be selected as a function of the utilized method and desired efficiency.

In one advantageous refinement, the primary conductors are at least partially encapsulated and/or protected by a cover. This

offers the advantage that a particularly high degree of protection is attainable.

In one advantageous refinement, the drive unit is impervious, smooth on the outer surface, and/or manufactured to have a high degree of protection. In this context, it is advantageous that the drive unit may be provided, in particular, for use in wet areas and/or aseptic areas.

In one advantageous refinement, the drive unit does not include a plug-and-socket connector or other electrical connection terminals on its exterior. In this context, it is, in turn, advantageous that the drive unit may be easily manufactured to be impervious and to provide a high degree of protection.

Further advantages are yielded from the dependent claims.

List of Reference Numerals

1	housing
2	rotor shaft
3	housing part
4	primary conductor
5	primary conductor
6	indentation
7	core having a U-shaped cross-section
21	primary conductor
22	primary conductor
23	clip
24	groove
25	groove
26	housing part
27	core having a U-shaped cross-section
28	second core having a U-shaped cross-section
31	cover
32	primary conductor
33	primary conductor
34	cable duct
35	core having an E-shaped profile
36	core having an E-shaped profile
37	printed circuit board
41	turntable
42	turntable drive
43	primary conductor
44	drive unit
45	stationary coil cores

The present invention will now be explained in detail with reference to figures:

An isometric view, a sectional view, and a plan view of the drive unit according to the present invention are shown in Figures 1a, 1b, and 1c. The drive unit includes an electric motor having a rotor shaft 2, which is surrounded by a housing 1. The electronic circuit for powering and controlling the electric motor is substantially protected by housing part 3, which has an indentation 6 in which a primary conductor is secured, using a winding loop. The return line, i.e. the second primary conductor, is only lead through, i.e. not wrapped around the drive unit.

Housing part 3 contains a core 7 having a U-shaped cross-section, around which a secondary winding is laid that powers the electronic circuit. Therefore, the drive unit may be powered by the inductive coupling in a contactless manner, and is therefore galvanically separated from the primary circuit. The power supply of the drive unit may be disconnected rapidly and easily by unwinding or taking down the loop of the primary conductor.

The primary circuit is powered by a device, which exhibits a current-source behavior with respect to the primary current generated by it.

In further exemplary embodiments of the present invention, information is transmitted by modulating higher-frequency signals onto the primary conductor, as the electronic circuit includes means for demodulating the signals. To exchange information, the electronic circuit also includes means of modulation, which means that signals may also be modulated onto the primary conductor.

In this manner, the drive unit may be powered in a contactless manner. The consequence of this is that a novel powering principle may be realized in industrial systems and/or machines, for during the installation of the drive units, these must no longer be electrically connected and wired with the aid of expensive plug-and-socket connectors, but rather it is sufficient for a primary conductor to be wrapped around in the indentation of the drive unit.

In addition, a high degree of protection is realizable, since plug-and-socket connectors are eliminated and the drive unit may therefore be inexpensively manufactured, along with its housing, so as to be impervious. Therefore, the drive unit may be manufactured to have, in particular, a smooth housing and is consequently usable in aseptic applications or wet applications.

Means for potential segregation and other separating devices may be eliminated, since the wall thickness of the housing may be appropriately dimensioned and the inductive coupling may be easily disconnected.

Of course, the electronic circuit also includes the secondary-side means for transmitting power inductively, i.e. without contact. In an advantageous variant, these means are advantageously passive components, i.e. capacitors and windings about coil cores. In the simplest embodiment, the transformer head is wrapped with a winding in the form of a secondary winding, and a capacitor, whose capacitance is in resonance with the inductance of the winding, is connected in outgoing circuit, the resonance frequency corresponding to the frequency of the alternating current in the primary conductor or deviating from it by not more than 10%.

The drive units may be powered in series by the primary conductor. It is possible to decouple individual motors without having to interrupt the power supply of the others. It is only necessary to remove the primary-conductor loop around the drive unit, e.g. by lifting the conductor loop out of the indentation.

The wiring of the present invention eliminates the need for T-pieces.

The drive unit is drawn as a rotary drive in Figures 1a, 1b, and 1c. In other exemplary embodiments of the present invention, the drive unit is implemented as a linear drive and is inductively powered.

In further exemplary embodiments of the present invention for drive units, according to Figures 2a, 2b, and 2c, cores 27, 28 having a U-shaped cross-section are located on the B-side with grooves for primary conductors 21 and 22. A clip 23 is used for fixing the primary conductors in position in their grooves. Only one core 27 is necessary for functioning. Additional core 28 increases the efficiency of the entire device. The secondary windings on the two cores 27, 28 are interconnected and power the electronic circuit, which is, in turn, situated in the region of housing cover 26 that is provided on the B-side of housing 1.

In further exemplary embodiments of the present invention for drive units, according to Figures 3a, 3b, 3c, 3d, 3e, 3f, 3g, and 3h, which show different views, some that mask material components as in Figure 3b, first primary conductor 32 is run in a cable duct 34, which is provided in a semi-loop pointing upwards. Second primary conductor 33 is run in a corresponding semi-loop pointing downwards. For purposes of inductive coupling, an E-shaped core 36 is provided in the upper semi-

loop, and a second E-shaped core 35 is provided in the lower semi-loop, in particular in the material of the cover. The legs of the E of the E-shaped cores are brought forward to housing part 37. Housing part 37 protects a printed circuit board that carries windings, which run in the shape of a spiral, are produced as conductor tracks, and are provided as secondary windings. In particular, a flat, E-shaped core is placed on this printed circuit board and oriented in such a manner, that its legs meet the legs of E-shaped core 36 when extended. Therefore, a highly effective, inductive coupling is attainable, as indicated in Figure 3i. The printed circuit board may also be fitted with additional electronic components.

The function of cover 31 shown in Figure 3a is to provide mechanical protection, and to be a clamping device, i.e. strain-relief device. In Figure 3b, the material of cover 31 is omitted, so that E-shaped cores 35, 36 are visible, as well as cable ducts 34. The cover may be detachably screwed to housing 1.

In further exemplary embodiments of the present invention, this cover includes magnetically conductive material for improved energy coupling. In particular, this material is also advantageously formed in the shape of a U or E.

In further exemplary embodiments of the present invention, primary conductors 32, 33 in the cable ducts are provided with encapsulating material for fixing them in position and sealing them.

Shown in 5a, 5b, 5c, 5d, 5e, 5f, and 5g are different views of an industrial system of the present invention, which includes drive units of the present invention.

In this context, a turntable 41 driven by turntable drive 42 is rotatable relative to stationary coil cores 45, which carry a coil for generating a medium-frequency, alternating field. The primary conductor passes through stationary coil core 45 and is therefore inductively coupled to the coil. In this manner, power may be transmitted in a contactless manner from the coil to primary conductor 43, which leads, in turn, to drives 44 and likewise powers them in a contactless manner. A considerable advantage is that in wet applications or aseptic applications, or in the food-processing and luxury-food industries, the system may therefore be manufactured to provide a particularly high degree of protection and to be easily cleanable. In addition, the primary conductor may be installed simply and rapidly, and the manufacturing costs and maintenance costs of the entire system are therefore reducible.

In particular, the primary conductor is laid in a closed path and is wound around each drive unit once.

A corresponding, further exemplary embodiment of the present invention is shown in Figure 4.

In further exemplary embodiments of the present invention, the primary conductor is wound several times around a drive unit 44.

In other exemplary embodiments of the present invention, primary conductor 43 is powered by a loop line instead of in a contactless manner.

In Figures 4 and 5, the drive units are shown mounted on a turntable 41. However, other exemplary embodiments of the present invention also provide for the drive units to be positioned under the turn table or at other locations.

In other exemplary embodiments of the present invention, a linearly movable table, on which the drive units are positioned, is provided in place of the turntable. The coil cores are then positioned along the path of motion and power the primary conductor that is laid in an essentially linear manner.

In other exemplary embodiments of the present invention according to Figure 4 or Figure 5, at least one different drive unit of Figure 2 or 3 is used in place of the drive units of Figure 1.

The method for contact-free energy transmission and the corresponding components are advantageously implementable in advantageous specific embodiments according to the features described in documents DE 100 53 373, DE 103 12 284, DE 103 12 792, DE 103 39 340, DE 103 38 852, DE 103 49 242, DE 103 44 144, DE 44 46 779, or also WO 92/17929. In this context, it is particularly advantageous to use a medium frequency of approximately 15 to 30 kHz. The adapter circuit following the transformer head, including the coil core, may be manufactured to be passive in a particularly advantageous manner, i.e. without electronic power semiconductors.